METHOD FOR PRODUCING MULTILAYERS ON A SUBSTRATE

TECHNICAL FIELD

[0001] This invention relates to a method for producing multilayers on a receiving substrate. This method makes it possible among other things to produce a resonant cavity structure comprising an active layer that transmits or detects light interposed between two reflecting mirrors.

PRIOR ART

[0002] The production of multilayers (for example GaAs-type III-V multilayers) on a substrate is generally achieved by means of the following steps:

[0003] the production of a stack of layers by growth of a barrier layer (for example AlAs), then an active layer (for example GaAs) on a supporting substrate (for example GaAs),

[0004] the implantation of gaseous species such as H, He, noble gases, and so on in the supporting substrate,

[0005] bonding, by means of molecular adhesion, the stack to a receiving substrate (for example, made of silicon) to obtain a bonded structure,

[0006] fracturing the supporting substrate at the level of the implanted zone, which fracture is caused by a heat treatment and/or the application of mechanical stresses on the bonded implanted structure; this results in the supporting substrate (which can be reused), having a thin film been taken from it, and the receiving substrate onto which the active layer, the barrier layer and the thin film taken from the supporting substrate are transferred,

[0007] selective etchings of the thin film taken from the supporting substrate, and the barrier layer,

[0008] growth of multilayers (for example III-V) from the active layer transferred onto the receiving substrate; the growth can be achieved by epitaxy, for example.

[0009] According to the applications, the multilayers produced on the active layer arranged on the receiving substrate can then undergo various technical steps related to the production of a variety of devices, such as photovoltaic cells.

[0010] In this series of steps, it is the step of selective etching that raises a problem. Indeed, to be capable of obtaining high-quality multilayers compatible with the intended application, it is necessary for the thin film and the barrier layer to be integrally etched without the active layer being affected by this. In addition, if the active layer is to be compatible with epitaxial growth, its surface must be smooth and clean, of low roughness and without crystallographic defects or impurities.

[0011] According to document [1], the selective etching step can be performed by chemical attack. To do this, a solution is used to selectively etch the thin film with respect to the barrier layer, then a solution is used to selectively etch the barrier layer with respect to the active layer. The choice of chemical attack for carrying out the selective etchings has disadvantages. Indeed, this choice requires the use of two different chemical solutions specific to the type of layers to remove/preserve. Moreover, selective etching by chemical attack can cause defects in the active layer and/or modify its surface (for example, its roughness, etc.).

[0012] In addition, etching the thin film exposes the barrier layer. However, depending on its composition, the barrier layer can be damaged by contact with the air (for example, if the barrier layer is made of AlAs). In this case, this oxidation layer should be removed in an additional etching step which complicates the method for producing multilayers.

DESCRIPTION OF THE INVENTION

[0013] We propose an original approach to the production of multilayers on a receiving substrate, which does not have the disadvantages mentioned above.

[0014] The invention relates to a method for producing a multilayer on a receiving substrate, which includes the following steps:

[0015] the formation of an initial substrate comprising a layer of a first material formed on the surface of a supporting substrate made of a second material, wherein the first material has a higher evaporation temperature than the evaporation temperature of the second material,

[0016] bonding, by means of molecular adhesion, the surface of the initial substrate comprising the first material layer to the bonding surface of a receiving substrate so as to obtain a bonded structure,

[0017] partially removing the initial substrate so as to leave a thin layer of said second material on the first material layer,

[0018] evaporating the second material thin film with a selective stop on the first material layer, which evaporation is carried out at a temperature higher than or equal to the evaporation temperature of the second material, and lower than the evaporation temperature of the first material,

[0019] growth of at least one layer from the first material layer bonded to the receiving substrate,

[0020] wherein the evaporation step and the growth step are carried out in the same technological apparatus. In other words, the growth and the evaporation are realised in the same technological apparatus ("epitaxy apparatus), i.e. without intermediate contact to the air. "Evaporation temperature of a material" means the temperature at which its evaporation rate becomes significant (typically around several nanometers per minute).

[0021] Advantageously, the second material supporting substrate is a second material substrate or a second material layer formed on a predetermined substrate.

[0022] The method also advantageously includes, before the bonding step, a step of forming at least one additional layer on the first material layer. This at least one additional layer can serve among other things as a protective layer for the first material layer. This can also be a bonding layer (for example made of SiO_2).

[0023] Advantageously, the receiving substrate also comprises at least one layer on its bonding surface, for example made of SiO_2.